PB90-252602

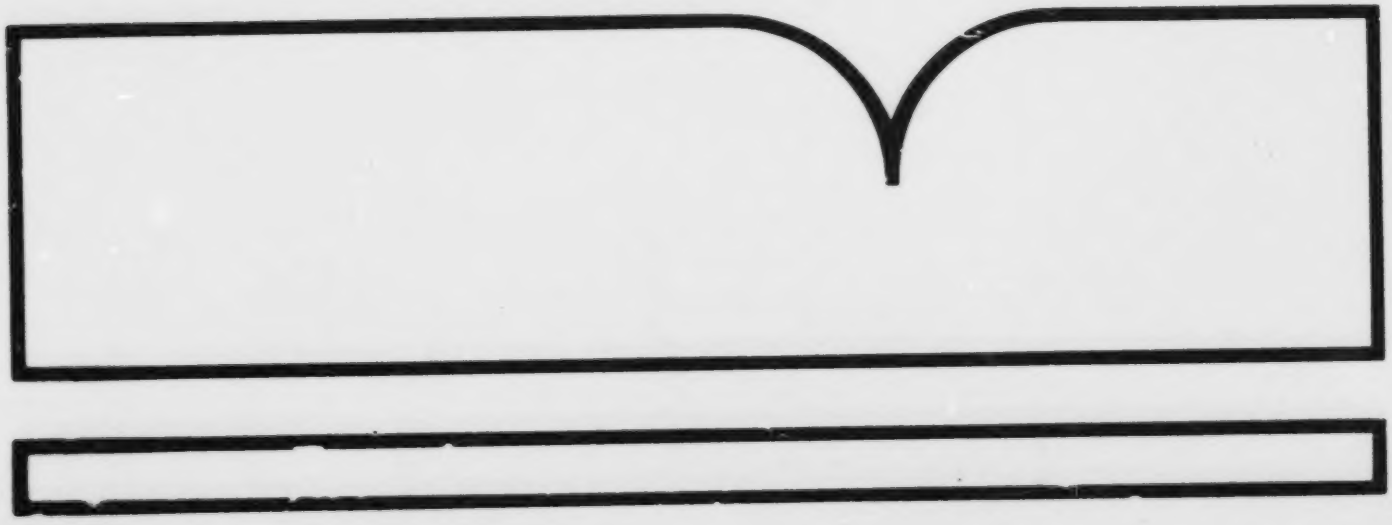
Emerging Technologies: Bio-Recovery Systems Removal and Recovery of Metal Ions from Groundwater. Appendices

Bio-Recovery Systems, Inc., LasCruces, NM

Prepared for:

Environmental Protection Agency, Cincinnati, OH

Aug 90



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August 1990

Emerging Technologies:

Bio-Recovery Systems Removal and Recovery of Metal Ions from Groundwater Appendices

Risk Reduction Engineering Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

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16. ABSTRACT

A series of laboratory tests and an on-site pilot scale demonstration of Bio-Recovery Systems' AlgaSORB technology for the removal and recovery of mercury-contaminated groundwater were conducted under the SITE program.

Optimum conditions were determined for mercury binding to AlgaSORB. Conditions under which mercury could be stripped from AlgaSORB were developed.

On-site, pilot scale demonstrations with a portable waste treatment system incorporating columns containing two different AlgaSORB preparations confirmed laboratory tests. Over 500 bed volumes of mercury-contaminated groundwater could be successfully treated before regeneration of the system was required. Mercury was removed to levels below the discharge limit of 10 ug/L.

17. KEY WORDS AND DOCUMENT ANALYSIS

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DISCLAIMER

The information in this document has been funded in part by the United States Environmental Protection Agency under Cooperative Agreement No. CR-815318010 to Bio-Recovery Systems, Inc. The document has been subjected to the Agency's administrative and peer review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. As the enforcer of national environmental laws, the EPA strives to balance human activities and the ability of natural systems to support and nurture life. A key part of the EPA's effort is its research into our environmental problems to find new and innovative solutions.

The Risk Reduction Engineering Laboratory (RREL) is responsible for planning, implementing, and managing research, development, and demonstration programs to provide an authoritative, defensible engineering basis in support of the policies, programs, and regulations of the EPA with respect to drinking water, wastewater, pesticides, toxic substances, solid and hazardous wastes, and Superfund-related activities. This publication is one of the products of that research and provides a vital communication link between the researcher and the user community.

Now in its fourth year, the Superfund Innovative Technology Evaluation (SITE) Program is part of EPA's research into cleanup methods for hazardous waste sites around the nation. Through cooperative agreements with developers, alternative or innovative technologies are refined at the bench-and pilot-scale level and then demonstrated at actual sites. EPA collects and evaluates extensive performance data on each technology to use in remediation decision-making for hazardous waste sites.

These appendices include the laboratory analysis results from two independent laboratories that were provided split samples from Bio-Recovery Systems, Inc. during the on-site pilot testing of Bio-Recovery's technology for the removal of mercury from contaminated groundwaters during the period of November 7, 1989 to December 1, 1989.

E. Timothy Oppelt, Director
Risk Reduction Engineering Laboratory

ABSTRACT

A series of laboratory tests and an on-site pilot scale demonstration of Bio-Recovery Systems' AlgaSORB® technology for the removal and recovery of mercury-contaminated groundwaters were conducted under the SITE program.

Optimum conditions were determined for mercury binding to AlgaSORB®. Conditions under which mercury could be stripped from AlgaSORB® were also developed.

On-site, pilot scale demonstrations with a portable waste treatment system incorporating columns containing two different AlgaSORB® preparations confirmed laboratory tests. Over 500 bed volumes of mercury-contaminated groundwater could be successfully treated before regeneration of the system was required. Mercury was removed to levels below the discharge limit of 10 µg/L.

This report was submitted in fulfillment of Cooperative Agreement Number CR 815318010 by Bio-Recovery Systems, Inc. under the partial sponsorship of the U.S. Environmental Protection Agency. This report covers a period from October, 1988 to January 31, 1990, and work was completed as of January 31, 1990.

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APPENDIX A

MERCURY ANALYSIS BY WOODWARD-CLYDE CONSULTANTS
DURING ON-SITE PILOT SCALE TESTING

Chain of Custody # 890334

November 9, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 8, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Marilyn R. Arsenault
Lab Manager

COC# 890334

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890334-01-01	444-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-02-01	445-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-03-01	446-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-04-01	447-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-05-01	448-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-06-01	449-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-07-01	450-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-08-01	451-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-09-01	452-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1
890334-10-01	453-110889	WATER	11-08-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890334-09

COC# 890334

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	106	106	106	0	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890334-09
Concentration Units: ug/L

COC# 890334

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	ND	10.6	10.0	106	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	ND	10.6	10.0	106	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

COC# 890334

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-08-89	11-08-89	0.2	ND
890334-01-01	444-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	4.1
890334-02-01	445-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	7.1
890334-03-01	446-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	7.1
890334-04-01	447-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	7.6
890334-05-01	448-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	7.3
890334-06-01	449-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	8.1
890334-07-01	450-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	8.0
890334-08-01	451-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	8.1
890334-09-01	452-110889	WATER	11-08-89	11-08-89	11-08-89	0.2	ND
890334-10-01	453-110889	WATER	11-08-89	11-08-89	11-08-89	20	500
890334-10-01D	453-110889	WATER	11-08-89	11-08-89	11-08-89	20	490

REVIEWED BY: Loreli C. Cruz

Chain of Custody # 890331

November 8, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 7, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Marilyn R. Arsenault
Lab Manager

COC# 890331

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890331-01-01	436-110789	WATER	11-07-89	1-500ml PLASTIC	EPA 245.1
890331-02-01	437-110789	WATER	11-07-89	1-500ml PLASTIC	EPA 245.1
890331-03-01	438-110789	WATER	11-07-89	1-500ml PLASTIC	EPA 245.1
890331-04-01	439-110789	WATER	11-07-89	1-500ml PLASTIC	EPA 245.1
890331-05-01	440-110789	WATER	11-07-89	1-500ml PLASTIC	EPA 245.1
890331-06-01	441-110789	WATER	11-07-89	1-500ml PLASTIC	EPA 245.1
890331-07-01	442-110789	WATER	11-07-89	1-500ml PLASTIC	EPA 245.1
890331-08-01	443-110789	WATER	11-07-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890331-02

COC# 890331

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	112	114	113	2	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890331-02
Concentration Units: ug/L

COC# 890331

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	0.4	6.0	5.0	112	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	0.4	6.1	5.0	114	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

COC# 890331

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID HARRS

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-07-89	11-07-89	0.2	ND
890331-01-01	436-110789	WATER	11-07-89	11-07-89	11-07-89	20	780
890331-02-01	437-110789	WATER	11-07-89	11-07-89	11-07-89	0.2	0.4
890331-03-01	438-110789	WATER	11-07-89	11-07-89	11-07-89	0.2	0.5
890331-04-01	439-110789	WATER	11-07-89	11-07-89	11-07-89	0.2	14.2
890331-05-01	440-110789	WATER	11-07-89	11-07-89	11-07-89	0.2	2.6
890331-06-01	441-110789	WATER	11-07-89	11-07-89	11-07-89	0.2	2.4
890331-07-01	442-110789	WATER	11-07-89	11-07-89	11-07-89	0.2	2.2
890331-08-01	443-110789	WATER	11-07-89	11-07-89	11-07-89	0.2	3.7

REVIEWED BY: Ana Luis Provancha

Chain of Custody # 890335

November 10, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 9, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Aura I. Provancher
Acting Lab Manager

COC# 890335

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890335-01-01	457-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-02-01	458-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-03-01	459-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-04-01	460-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-05-01	461-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-06-01	462-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-07-01	463-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-08-01	464-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-09-01	465-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1
890335-10-01	466-110989	WATER	11-09-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890335-09

COC# 890335

Parameter	Spike Concentration Measured			Precision	Laboratory Control Limit
	%REC 1	% REC 2	Avg. %REC	RPD	for Precision
MERCURY	110	106	108	4	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890335-09
Concentration Units: ug/L

COC# 890335

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	ND	5.5	5.0	110	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	ND	5.3	5.0	106	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

COC# 890335

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-09-89	11-09-89	0.2	ND
890335-01-01	457-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	8.0
890335-02-01	458-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	8.4
890335-03-01	459-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	10.4
890335-04-01	460-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	10.7
890335-05-01	461-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	10.4
890335-06-01	462-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	10.4
890335-07-01	463-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	10.9
890335-08-01	464-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	10.5
890335-09-01	465-110989	WATER	11-09-89	11-09-89	11-09-89	0.2	ND
890335-10-01	466-110989	WATER	11-09-89	11-09-89	11-09-89	20	330

REVIEWED BY: Anna Inés Prowancher

Chain of Custody # 890338

November 14, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 13, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Marilyn R. Arsenault
Lab Manager

COC# 890338

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890338-01-01	473-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-02-01	474-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-03-01	475-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-04-01	476-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-05-01	477-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-06-01	478-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-07-01	479-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-08-01	480-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-09-01	481-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1
890338-10-01	482-111389	WATER	11-13-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890338-01

COC# 890338

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	82	81	82	1	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890338-01
Concentration Units: ug/L

COC# 890338

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	0.5	16.9	20.0	82	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	0.5	16.7	20.0	81	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

COC# 890338

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID HARRS

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	11-13-89	11-13-89	11-13-89	0.2	ND
890338-01-01	473-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	0.5
890338-02-01	474-111389	WATER	11-13-89	11-13-89	11-13-89	20	490
890338-03-01	475-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	13.0
890338-04-01	476-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	3.3
890338-05-01	477-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	2.8
890338-06-01	478-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	3.1
890338-07-01	479-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	3.0
890338-08-01	480-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	3.6
890338-09-01	481-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	3.0
890338-10-01	482-111389	WATER	11-13-89	11-13-89	11-13-89	0.2	3.1

REVIEWED BY: Cornelius C. Cruz

Chain of Custody # 890339

November 15, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8810153A) samples which were received at Woodward-Clyde Analytical Laboratory November 14, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Aura I. Provancher
Acting Lab Manager

COC# 890339

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890339-01-01	487-111489	WATER	11-14-89	1-500ml PLASTIC	EPA 245.1
890339-02-01	488-111489	WATER	11-14-89	1-500ml PLASTIC	EPA 245.1
890339-03-01	489-111489	WATER	11-14-89	1-500ml PLASTIC	EPA 245.1
890339-04-01	490-111489	WATER	11-14-89	1-500ml PLASTIC	EPA 245.1
890339-05-01	491-111489	WATER	11-14-89	1-500ml PLASTIC	EPA 245.1
890339-06-01	492-111489	WATER	11-14-89	1-500ml PLASTIC	EPA 245.1
890339-07-01	493-111489	WATER	11-14-89	1-500ml PLASTIC	EPA 245.1
890339-08-01	494-111489	WATER	11-14-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890339-02 COC# 890339

Parameter	Spike Concentration Measured %REC 1	% REC 2	Avg. %REC	Precision RPD	Laboratory Control Limit for Precision
MERCURY	102	108	105	6	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890339-02
Concentration Units: ug/L

COC# 890339

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	810	1320	500	102	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	810	1350	500	108	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

COC# 890339

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	11-14-89	11-14-89	11-14-89	0.2	ND
890339-01-01	487-111489	WATER	11-14-89	11-14-89	11-14-89	0.2	ND
890339-02-01	488-111489	WATER	11-14-89	11-14-89	11-14-89	20	810
890339-03-01	489-111489	WATER	11-14-89	11-14-89	11-14-89	0.2	4.8
890339-04-01	490-111489	WATER	11-14-89	11-14-89	11-14-89	0.2	2.5
890339-05-01	491-111489	WATER	11-14-89	11-14-89	11-14-89	0.2	2.2
890339-06-01	492-111489	WATER	11-14-89	11-14-89	11-14-89	0.2	2.7
890339-07-01	493-111489	WATER	11-14-89	11-14-89	11-14-89	0.2	2.7
890339-08-01	494-111489	WATER	11-14-89	11-14-89	11-14-89	0.2	2.7

REVIEWED BY: Ana Luis Provancher

Chain of Custody # 890343

November 17, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 15, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Marilyn R. Arsenault
Lab Manager

COC# 890343

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890343-01-01	495-111589	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1
890343-02-01	496-111589	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1
890343-03-01	497-111589	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1
890343-04-01	498-111589	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1
890343-05-01	499-111589	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1
890343-06-01	500-111589	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1
890343-07-01	501-111589	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1
890343-08-01	502-111589	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1
890343-09-01	244BV	WATER	11-15-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: LCS-9922

COC# 890343

Parameter	Spike Concentration Measured %REC 1	% REC 2	Avg. %REC	Precision RPD	Laboratory Control Limit for Precision
MERCURY	114	109	112	4	20

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890343-08

COC# 890343

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	103	101	102	2	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: LCS-9922
Concentration Units: ug/L

COC# 890343

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	ND	7.3	6.4	114	75-117

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	ND	7.0	6.4	109	75-117

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890343-08 COC# 890343
Concentration Units: ug/L

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	740	1770	1000	103	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	740	1750	1000	101	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID HARRS

COC# 890343

UCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-15-89	11-15-89	0.2	ND
890343-01-01	495-111589	WATER	11-15-89	11-15-89	11-15-89	0.2	4.1
890343-02-01	496-111589	WATER	11-15-89	11-15-89	11-15-89	0.2	2.3
890343-03-01	497-111589	WATER	11-15-89	11-15-89	11-15-89	0.2	1.4
890343-04-01	498-111589	WATER	11-15-89	11-15-89	11-15-89	0.2	2.1
890343-05-01	499-111589	WATER	11-15-89	11-15-89	11-15-89	0.2	2.3
890343-06-01	500-111589	WATER	11-15-89	11-15-89	11-15-89	0.2	2.7
890343-07-01	501-111589	WATER	11-15-89	11-15-89	11-15-89	0.2	ND
890343-08-01	502-111589	WATER	11-15-89	11-15-89	11-15-89	20	700
890343-08-01D	502-111589	WATER	11-15-89	11-16-89	11-16-89	20	740
890343-09-01	244BV	WATER	11-15-89	11-16-89	11-16-89	2	41

REVIEWED BY: Ana Luis Porancker

Chain of Custody # 890344

November 17, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 16, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Marilyn R. Arsenault
Lab Manager

COC# 890344

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890344-01-01	503-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-02-01	504-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-03-01	505-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-04-01	506-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-05-01	507-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-06-01	508-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-07-01	509-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-08-01	510-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-09-01	511-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-10-01	512-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1
890344-11-01	513-111689	WATER	11-16-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 7470
WCC Lab ID: 890343-08

COC# 890344

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	103	101	102	2	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890343-08
Concentration Units: ug/L

COC# 890344

SPIKE 1

Parameter	Diluted Concentration		True Concentration	Internal Accuracy	Laboratory Control Limits for % Recovery
	Sample	Spiked Sample	Spike	% Recovery	
MERCURY	740	1770	1000	103	80-120

SPIKE 2

Parameter	Diluted Concentration		True Concentration	Internal Accuracy	Laboratory Control Limits for % Recovery
	Sample	Spiked Sample	Spike	% Recovery	
MERCURY	740	1750	1000	101	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

COC# 890344

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-16-89	11-16-89	0.2	ND
890344-01-01	503-111689	WATER	11-16-89	11-16-89	11-16-89	0.2	4.3
890344-02-01	504-111689	WATER	11-16-89	11-16-89	11-16-89	0.2	2.6
890344-03-01	505-111689	WATER	11-16-89	11-16-89	11-16-89	0.2	2.6
890344-04-01	506-111689	WATER	11-16-89	11-16-89	11-16-89	0.2	2.7
890344-05-01	507-111689	WATER	11-16-89	11-16-89	11-16-89	0.2	2.6
890344-06-01	508-111689	WATER	11-16-89	11-16-89	11-16-89	0.2	2.9
890344-07-01	509-111689	WATER	11-16-89	11-16-89	11-16-89	0.2	2.6
890344-08-01	510-111689	WATER	11-16-89	11-16-89	11-16-89	0.2	ND
890344-09-01	511-111689	WATER	11-16-89	11-16-89	11-16-89	20	730
890344-10-01	512-111689	WATER	11-16-89	11-16-89	11-16-89	2	28
890344-11-01	513-111689	WATER	11-16-89	11-16-89	11-16-89	2	40

REVIEWED BY: Ana Inés Piovanchy

Chain of Custody # 890345

November 20, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 17, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Marilyn R. Arsenault
Lab Manager

COC# 890345

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890345-01-01	514-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-02-01	515-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-03-01	516-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-04-01	517-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-05-01	518-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-06-01	519-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-07-01	520-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-08-01	521-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-09-01	522-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-10-01	523-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-11-01	524-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1
890345-12-01	525-111789	WATER	11-17-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890345-08

COC# 890345

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	99	95	97	4	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890345-08
Concentration Units: ug/L

COC# 890345

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	2.8	12.7	10	99	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	2.8	12.3	10	95	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

COC# 890345

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-17-89	11-17-89	0.2	ND
890345-01-01	514-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	4.0
890345-02-01	515-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	2.4
890345-03-01	516-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	2.4
890345-04-01	517-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	2.4
890345-05-01	518-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	2.5
890345-06-01	519-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	2.3
890345-07-01	520-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	2.4
890345-08-01	521-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	2.8
890345-09-01	522-111789	WATER	11-17-89	11-17-89	11-17-89	0.2	ND
890345-10-01	523-111789	WATER	11-17-89	11-17-89	11-17-89	20	690
890345-11-01	524-111789	WATER	11-17-89	11-17-89	11-17-89	2	33
890345-12-01	525-111789	WATER	11-17-89	11-17-89	11-17-89	2	38

REVIEWED BY: Ana Inés Roncancio

Chain of Custody # 890346

November 27, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 20, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Aura Luis Provancher

Aura I. Provancher
Acting Lab Manager

COC# 890346

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890346-01-01	526-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-02-01	527-112089	WATER	11-20-89*	1-500ml PLASTIC	EPA 245.1
890346-03-01	528-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-04-01	529-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-05-01	530-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-06-01	531-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-07-01	532-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-08-01	533-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-09-01	534-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-10-01	535-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-11-01	536-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1
890346-12-01	537-112089	WATER	11-20-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: LCS-9922 COC# 890346

Parameter	Spike Concentration Measured			Precision	Laboratory Control Limit
	%REC 1	% REC 2	Avg. %REC	RPD	for Precision
MERCURY	100	100	100	0	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: LCS-9922
Concentration Units: ug/L

COC# 890346

SPIKE 1

Parameter	Diluted Concentration		True Concentration	Internal Accuracy	Laboratory Control Limits for % Recovery
	Sample	Spiked Sample	Spike	% Recovery	
MERCURY	ND	6.4	6.4	100	80-120

SPIKE 2

Parameter	Diluted Concentration		True Concentration	Internal Accuracy	Laboratory Control Limits for % Recovery
	Sample	Spiked Sample	Spike	% Recovery	
MERCURY	ND	6.4	6.4	100	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

COC# 890346

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

UCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-21-89	11-21-89	0.2	ND
890346-01-01	526-112089	WATER	11-20-89	11-21-89	11-21-89	20	850
890346-02-01	527-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	9.3
890346-03-01	528-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	4.1
890346-04-01	529-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	0.3
890346-05-01	530-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	0.5
890346-06-01	531-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	0.8
890346-07-01	532-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	2.6
890346-08-01	533-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	3.1
890346-09-01	534-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	4.1
890346-10-01	535-112089	WATER	11-20-89	11-21-89	11-21-89	0.4	32.9
890346-11-01	536-112089	WATER	11-20-89	11-21-89	11-21-89	0.4	25.7
890346-12-01	537-112089	WATER	11-20-89	11-21-89	11-21-89	0.2	3.0

REVIEWED BY: Ana Inés Provancher

Chain of Custody # 890348

November 27, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 21, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Aura Luis Provancher

Aura I. Provancher
Acting Lab Manager

COC# 890348

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890348-01-01	538-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-02-01	539-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-03-01	540-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-04-01	541-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-05-01	542-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-06-01	543-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-07-01	544-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-08-01	545-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-09-01	546-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-10-01	547-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-11-01	548-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1
890348-12-01	549-112189	WATER	11-21-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890347-01

COC# 890348

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	102	96	99	6	20

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890351-06

COC# 890348

Parameter	Spike Concentration Measured			Precision	Laboratory Control Limit
	%REC 1	% REC 2	Avg. %REC	RPD	for Precision
MERCURY	100	102	101	2	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890347-01 COC# 890348
Concentration Units: ug/L

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	2.0	7.1	5.0	102	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	2.0	6.8	5.0	96	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890351-06 COC# 890348
Concentration Units: ug/L

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	38	88	50	100	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	38	89	50	102	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARR

COC# 890348

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-21-89	11-21-89	0.2	ND
890348-01-01	538-112189	WATER	11-21-89	11-21-89	11-21-89	20	970
890348-02-01	539-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	1.3
890348-03-01	540-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	4.3
890348-04-01	541-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	3.4
890348-05-01	542-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	6.3
890348-06-01	543-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	4.6
890348-07-01	544-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	3.2
890348-08-01	545-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	2.9
890348-09-01	546-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	2.7
890348-10-01	547-112189	WATER	11-21-89	11-21-89	11-21-89	0.2	2.5
890348-11-01	548-112189	WATER	11-21-89	11-28-89	11-28-89	2	32
890348-12-01	549-112189	WATER	11-21-89	11-28-89	11-28-89	2	27

REVIEWED BY:

Chain of Custody # 890351

November 29, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 27, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Aura Inés Provancher

Aura I. Provancher
Acting Lab Manager

COC# 890351

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890351-01-01	550-112789	WATER	11-27-89	1-500ml PLASTIC	EPA 245.1
890351-02-01	551-112789	WATER	11-27-89	1-500ml PLASTIC	EPA 245.1
890351-03-01	552-112789	WATER	11-27-89	1-500ml PLASTIC	EPA 245.1
890351-04-01	553-112789	WATER	11-27-89	1-500ml PLASTIC	EPA 245.1
890351-05-01	554-112789	WATER	11-27-89	1-500ml PLASTIC	EPA 245.1
890351-06-01	555-112789	WATER	11-27-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890351-06

COC# 890351

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	100	102	101	2	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890351-06 COC# 890351
Concentration Units: ug/L

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	38	88	50	100	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	38	89	50	102	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

COC# 890351

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID HARRS

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-28-89	11-28-89	0.2	ND
890351-01-01	550-112789	WATER	11-27-89	11-28-89	11-28-89	20	1000
890351-02-01	551-112789	WATER	11-27-89	11-28-89	11-28-89	0.2	0.7
890351-03-01	552-112789	WATER	11-27-89	11-28-89	11-28-89	0.2	12.2
890351-04-01	553-112789	WATER	11-27-89	11-28-89	11-28-89	0.2	8.0
890351-05-01	554-112789	WATER	11-27-89	11-28-89	11-28-89	0.2	7.1
890351-06-01	555-112789	WATER	11-27-89	11-28-89	11-28-89	2	38

REVIEWED BY: Anna Inés Provancher

Chain of Custody # 890353

November 29, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 28, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Marilyn R. Arsenault
Lab Manager

COC# 890353

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890353-01-01	556-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-02-01	557-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-03-01	558-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-04-01	559-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-05-01	560-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-06-01	561-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-07-01	562-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-08-01	563-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-09-01	564-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-10-01	565-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-11-01	566-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1
890353-12-01	567-112889	WATER	11-28-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890353-01

COC# 890353

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	100	94	97	6	20

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890353-12

COC# 890353

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	108	112	110	4	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890353-01 COC# 890353
Concentration Units: ug/L

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	1000	1500	500	100	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	1000	1470	500	94	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890353-12
Concentration Units: ug/L

COC# 890353

SPIKE 1

Parameter	Diluted Concentration		True Concentration	Internal Accuracy	Laboratory Control Limits for % Recovery
	Sample	Spiked Sample	Spike	% Recovery	
MERCURY	53	107	50	108	80-120

SPIKE 2

Parameter	Diluted Concentration		True Concentration	Internal Accuracy	Laboratory Control Limits for % Recovery
	Sample	Spiked Sample	Spike	% Recovery	
MERCURY	53	109	50	112	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

COC# 890353

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-29-89	11-29-89	0.2	ND
890353-01-01	556-112889	WATER	11-28-89	11-29-89	11-29-89	20	1000
890353-02-01	557-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	1.0
890353-03-01	558-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	10.5
890353-04-01	559-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	7.7
890353-05-01	560-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	7.2
890353-06-01	561-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	6.9
890353-07-01	562-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	7.2
890353-08-01	563-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	7.5
890353-09-01	564-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	7.5
890353-10-01	565-112889	WATER	11-28-89	11-29-89	11-29-89	0.2	7.7
890353-11-01	566-112889	WATER	11-28-89	11-29-89	11-29-89	2	46
890353-12-01	567-112889	WATER	11-28-89	11-29-89	11-29-89	2	53

REVIEWED BY: Ana Lúcia Provancher

Chain of Custody # 890355

December 1, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 29, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Marilyn R. Arsenault
Lab Manager

COC# 890355

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890355-01-01	588-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-02-01	589-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-03-01	590-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-04-01	591-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-05-01	592-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-06-01	593-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-07-01	594-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-08-01	595-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-09-01	596-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-10-01	597-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-11-01	598-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1
890355-12-01	599-112989	WATER	11-29-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

II QUALITY CONTROL

A. PROJECT SPECIFIC QC. Spikes and duplicates were analyzed at approximately 10% of the sample load in order to establish field precision and laboratory accuracy and precision.

Field Precision is measured by using duplicate tests by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{sample concentration}) - (\text{duplicate sample concentration})|}{(\text{mean concentration of sample and duplicate sample})} * 100$$

Laboratory Precision is measured by using duplicate spikes by Relative Percent Difference (RPD) as in:

$$RPD = \frac{|(\text{Spike 1 \%REC}) - (\text{Spike 2 \%REC})|}{(\text{mean \%REC of Spike 1 and Spike 2})} * 100$$

Laboratory Accuracy (spike recovery) is measured by Percent Recovery (%REC) as in:

$$\%REC = \frac{(\text{spiked sample concentration}) - (\text{sample concentration})}{(\text{true concentration of the spike})} * 100$$

(See attached Field Precision* and Laboratory Precision and Accuracy summaries.)

B. METHOD PERFORMANCE. Precision and accuracy results were within EPA performance criteria for the method.

C. METHOD BLANK RESULTS. A method blank is a laboratory-generated sample which assesses the degree to which laboratory operations and procedures cause false-positive analytical results for your samples.

In the method blanks associated with these samples, target parameters were not detected at or above the practical quantitation limits noted on the data sheets in the Analytical Results Section. (See attached reagent water data sheet in Section III.)

* If Available

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890354-01

COC# 890355

Parameter	Spike Concentration Measured			Precision	Laboratory Control Limit
	%REC 1	% REC 2	Avg. %REC	RPD	for Precision
MERCURY	98	96	97	2	20

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890355-01

COC# 890355

Parameter	Spike Concentration Measured			Precision	Laboratory Control Limit
	%REC 1	% REC 2	Avg. %REC	RPD	for Precision
MERCURY	100	88	94	13	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890354-01
Concentration Units: ug/L

COC# 890355

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	0.7	5.6	5.0	98	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	0.7	5.5	5.0	96	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890355-01
Concentration Units: ug/L

COC# 890355

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	730	1230	500	100	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	730	1170	500	88	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

III ANALYSIS RESULTS

Test methods prefaced by "MODIFIED" indicate that minor modifications of published EPA Methods were made such as reporting limits or parameter lists. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e., no correction is made for moisture content. All data is "blank corrected" by subtracting the level of contamination, if any, found in the laboratory method blank from the analytical result before it is reported.

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

COC# 890355

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-30-89	11-30-89	0.2	ND
890355-01-01	588-112989	WATER	11-29-89	11-30-89	11-30-89	20	730
890355-02-01	589-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	0.8
890355-03-01	590-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	9.6
890355-04-01	591-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	10.1
890355-05-01	592-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	9.7
890355-06-01	593-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	9.9
890355-07-01	594-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	10.3
890355-08-01	595-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	10.7
890355-09-01	596-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	10.7
890355-10-01	597-112989	WATER	11-29-89	11-30-89	11-30-89	0.2	10.6
890355-11-01	598-112989	WATER	11-29-89	11-30-89	11-30-89	2	54
890355-12-01	599-112989	WATER	11-29-89	11-30-89	11-30-89	2	68

REVIEWED BY: Ana Lais Piovanchez

Chain of Custody # 890358

December 4, 1989

David Marrs
Woodward-Clyde Consultants
500 12th Street; Suite #100
Oakland, CA 94607-4014

Dear Mr. Marrs:

Enclosed is the report for (Project ID 8910153A) samples which were received at Woodward-Clyde Analytical Laboratory November 30, 1989.

The report consists of the following sections:

I Sample Description
II Quality Control
III Analysis Results

No problems were encountered with the analysis of your samples.

If you have any questions, please feel free to call.

Sincerely,

Aura Lés Provancher

Aura I. Provancher
Acting Lab Manager

COC# 890358

I SAMPLE DESCRIPTION

WCC LAB ID	SAMPLE ID	MATRIX	DATE SAMPLED	CONTAINERS	ANALYSIS DESCRIPTION
890358-01-01	600-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-02-01	601-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-03-01	602-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-04-01	603-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-05-01	604-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-06-01	605-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-07-01	606-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-08-01	607-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-09-01	608-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-10-01	609-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1
890358-11-01	610-113089	WATER	11-30-89	1-500ml PLASTIC	EPA 245.1

The samples were received under chain of custody, in good condition.

Laboratory Precision Summary

Analysis: 245.1
WCC Lab ID: 890358-01

COC# 890358

Parameter	Spike Concentration Measured			Precision RPD	Laboratory Control Limit for Precision
	%REC 1	% REC 2	Avg. %REC		
MERCURY	88	100	94	13	20

Laboratory Accuracy Summary

Analysis: 245.1
WCC LAB ID: 890358-01 COC# 890358
Concentration Units: ug/L

SPIKE 1

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	590	1030	500	88	80-120

SPIKE 2

Parameter	Diluted Concentration: Sample	Diluted Concentration: Spiked Sample	True Concentration: Spike	Internal Accuracy: % Recovery	Laboratory Control Limits for % Recovery
MERCURY	590	1090	500	100	80-120

Calculations are performed before rounding to avoid round-off errors in calculated results.

ND - Not Detected: sample contained the parameter below the practical quantitation limit

NA - Not Analyzed

MERCURY
EPA METHOD 245.1

PROJECT NAME: BIO RECOVERY SITE
PROJECT NUMBER: 8910153A
PROJECT MANAGER: DAVID MARRS

COC# 890358

WCC LAB ID	SAMPLE ID	MATRIX	COLLECTION DATE	DIGESTION DATE	ANALYSIS DATE	DETECTION LIMIT (ug/L)	MERCURY (ug/L)
METHOD BLANK	-	WATER	-	11-30-89	11-30-89	0.2	ND
890358-01-01	600-113089	WATER	11-30-89	11-30-89	11-30-89	20	590
890358-02-01	601-113089	WATER	11-30-89	11-30-89	11-30-89	0.2	0.8
890358-03-01	602-113089	WATER	11-30-89	11-30-89	11-30-89	0.2	13.9
890358-04-01	603-113089	WATER	11-30-89	11-30-89	11-30-89	0.2	12.1
890358-05-01	604-113089	WATER	11-30-89	11-30-89	11-30-89	0.2	12.8
890358-06-01	605-113089	WATER	11-30-89	11-30-89	11-30-89	0.2	13.2
890358-07-01	606-113089	WATER	11-30-89	11-30-89	11-30-89	0.2	13.2
890358-08-01	607-113089	WATER	11-30-89	11-30-89	11-30-89	0.2	13.2
890358-09-01	608-113089	WATER	11-30-89	11-30-89	11-30-89	0.2	13.0
890358-10-01	609-113089	WATER	11-30-89	11-30-89	11-30-89	2	61
890358-11-01	610-113089	WATER	11-30-89	11-30-89	11-30-89	2	107

REVIEWED BY: Ana Luis Lovanches

APPENDIX B

MERCURY ANALYSIS BY EER TECHNOLOGIES
DURING ON-SITE PILOT SCALE TESTING

EER TECHNOLOGIES CORPORATION

PROVIDING ANALYTICAL SUPPORT FOR
THE HAZARDOUS WASTE ENGINEERING RESEARCH LABORATORY
U.S. Environmental Protection Agency
26 W. Martin L. King Drive
Cincinnati, Ohio 45268

RECEIVED JAN 29 1990

January 11,1990

Ms. Sandy Svec
Chemist
Bio-Recovery Systems, Inc.
P.O. Box 3982
University Park Branch
Las Cruces, NM 88003

Dear Sandy:

Enclosed you will find the results of Mercury analysis. We use both a Gold Film Analyzer and AA Cold Vapor methods for analysis. QA/QC for both techniques are also enclosed.

If you have any questions, please feel free to call me at (513) 569-7693.

Sincerely,

Wipawan Nisamaneepong
Laboratory Manager

cc: N. Barkley

Hg Analysis by Gold Film and AA

Contractor:EER PAGE 1

Methods: 245.1
Analyst: R. Yeardley Requestor:Barkley, Svec

Sample Dates:12/1, 12/4/89 (Recieved)

Reporting Date: 1/9/90

Sample Matrix: Aqueous

Checked by: [illegible] 1/11 Approved by: [illegible] 1/11

DISK: lotus FILE NAME: hgfilm

EER LAB ID#	CLIENT SAMPLE ID	HG (ng/ml)	Date Recieved
09-00803*	603-113089	<10	12/1/89
90-00804*	589-112989	<10	12/1/89
90-00805*	594-112989	12	12/1/89
90-00806*	607-113089	<10	12/1/89
90-00807*	601-113089	<10	12/1/89
90-00808*	592-112989	<10	12/1/89
90-00809*	606-113089	11	12/1/89
90-00810*	602-113089	13	12/1/89
90-00811*	608-113089	15	12/1/89
90-00812*	600-113089	720	12/1/89
90-00813*	604-113089	11	12/1/89
90-00814*	591-112989	<10	12/1/89
90-00815	556-112889	1080	12/1/89
90-00816*	562-112889	<10	12/1/89
90-00817*	593-112989	11	12/1/89
90-00818*	595-112989	<10	12/1/89
90-00819*	605-113089	11	12/1/89
90-00820*	561-112889	<10	12/1/89
90-00821*	558-112889	33	12/1/89
90-00822	588-112989	700	12/1/89
90-00823	55-112789	970	12/1/89
90-00824*	596-112989	16	12/1/89
90-00825*	553-112789	20	12/1/89
90-00826*	552-112789	78	12/1/89
90-00827*	563-112889	30	12/1/89
90-00828*	565-112889	<10	12/1/89
90-00829*	590-112989	<10	12/1/89
90-00830*	597-112989	12	12/1/89
90-00831*	559-112889	<10	12/1/89
90-00832	436-110789	620	12/4/89
90-00833	437-110789	13	12/4/89
90-00834	438-110789	<10	12/4/89
90-00835	439-110789	11	12/4/89
90-00836	440-110789	11	12/4/89
90-00837	441-110789	11	12/4/89

EER LAB ID#	CLIENT SAMPLE ID	HG (ng/ml)	Date received
90-00838	442-110789	<10	12/4/89
90-00839	443-110789	11	12/4/89
90-00840	444-110889	<10	12/4/89
90-00841	445-110889	<10	12/4/89
90-00842	446-110899	<10	12/4/89
90-00843	447-110889	<10	12/4/89
90-00844	448-110889	<10	12/4/89
90-00845	449-110889	11	12/4/89
90-00846	450-110889	<10	12/4/89
90-00847	451-110869	<10	12/4/89
90-00848	452-110889	<10	12/4/89
90-00849	453-110889	370	12/4/89
90-00850	457-110989	<10	12/4/89
90-00851	458-110989	72	12/4/89
90-00852	459-110989	<10	12/4/89
90-00853	460-110989	<10	12/4/89
90-00854	461-110989	<10	12/4/89
90-00855	462-110989	32	12/4/89
90-00856	463-110989	11	12/4/89
90-00857	464-110989	18	12/4/89
90-00858	465-110989	<10	12/4/89
90-00859	466-110989	250	12/4/89
90-00860	473-111389	<10	12/4/89
90-00861	474-111389	350	12/4/89
90-00862	475-111389	13	12/4/89
90-00863	476-111389	<10	12/4/89
90-00864	477-111389	<10	12/4/89
90-00865	478-111389	<10	12/4/89
90-00866	479-111389	<10	12/4/89
90-00867	480-111389	<10	12/4/89
90-00868	481-111389	33	12/4/89
90-00869	482-111389	<10	12/4/89
90-00870	487-111489	<10	12/4/89
90-00871	488-111489	100	12/4/89
90-00872	489-111489	<10	12/4/89
90-00873	490-111489	<10	12/4/89
90-00874	491-111489	<10	12/4/89
90-00875	492-111489	<10	12/4/89
90-00876	493-111489	<10	12/4/89
90-00877	494-111489	<10	12/4/89
90-00878	495-111589	<10	12/4/89
90-00879	496-111589	<10	12/4/89
90-00880	497-111589	<10	12/4/89
90-00881	498-111589	<10	12/4/89
90-00882	499-111589	<10	12/4/89
90-00883	500-111589	<10	12/4/89
90-00884	501-111589	<10	12/4/89
90-00885	502-111589	470	12/4/89
90-00886	503-111689	17	12/4/89
90-00887	504-111689	<10	12/4/89
90-00888	505-111689	<10	12/4/89

EER LAB ID#	CLIENT SAMPLE ID	HG (ng/ml)	Date received
90-00889	506-111689	<10	12/4/89
90-00890	507-111689	<10	12/4/89
90-00891	508-111689	<10	12/4/89
90-00892	509-111689	<10	12/4/89
90-00893	510-111689	<10	12/4/89
90-00894	511-111689	10	12/4/89
90-00895	514-111789	<10	12/4/89
90-00896	515-111789	<10	12/4/89
90-00897	516-111789	<10	12/4/89
90-00898	517-111789	<10	12/4/89
90-00899	518-111789	<10	12/4/89
90-00900	519-111789	<10	12/4/89
90-00901	520-111789	<10	12/4/89
90-00902	521-111789	<10	12/4/89
90-00903	522-111789	<10	12/4/89
90-00904	523-111789	570	12/4/89
90-00905	526-111789	40	12/4/89
90-00906	527-112089	10	12/4/89
90-00907	528-112089	<10	12/4/89
90-00908	529-112089	850	12/4/89
90-00909	530-112089	<10	12/4/89
90-00910	531-112089	<10	12/4/89
90-00911	532-112089	<10	12/4/89
90-00912	533-112089	<10	12/4/89
90-00913	534-112089	<10	12/4/89
90-00914	537-112089	<10	12/4/89
90-00915	538-112189	570	12/4/89
90-00916	539-112189	<10	12/4/89
90-00917	540-112189	<10	12/4/89
90-00918	541-112189	<10	12/4/89
90-00919	542-112189	<10	12/4/89
90-00920	543-112189	<10	12/4/89
90-00921	544-112189	<10	12/4/89
90-00922	545-112189	<10	12/4/89
90-00923	546-112189	<10	12/4/89
90-00924	547-112189	<10	12/4/89
90-00925	551-112789	<10	12/4/89
90-00926	554-112789	10	12/4/89
90-00927	557-112889	21	12/4/89
90-00928	560-112889	<10	12/4/89
90-00929	564-112889	<10	12/4/89

* - Analysis by AA Method: Analyst - M. Templeton

SUMMARY OF QA/QC RESULTS FOR HG ANALYSIS ANALYST: RBY

FILE # hgqc DISC: lotus

DUPLICATE LAB ID	CLIENT SAMPLE ID	DUP. CONC. (ng/ml)	RELATIVE PERCENT DIFFERENCE
90-00838	442-110789	<10	NA
90-00848	452-110889	<10	NA
90-00858	465-111389	<10	NA
90-00860	473-111389	<10	NA
90-00870	487-111489	<10	NA
90-00880	497-111589	<10	NA
90-00882	499-111589	<10	NA
90-00891	508-111689	<10	NA
90-00901	520-111789	<10	NA
90-00915	538-112189	570	0%
90-00925	551-112789	<10	NA
90-00811*	608-113089	16	6.5%
90-00820*	561-112889	<10	NA
90-00829*	590-112989	<10	NA

SPIKE LAB ID	CLIENT SAMPLE ID	PERCENT (%) RECOVERY
90-00804	589-112989	87%
90-00807	601-113089	100%
90-00811	608-113089	71%
90-00813	604-113089	111%
90-00849	453-110889	80%
90-00859	466-110989	73%
90-00885	502-111589	69%
90-00891	508-111689	67%

SPIKE LAB ID	CLIENT SAMPLE ID	PERCENT (%) RECOVERY
90-00901	520-111789	78%
90-00925	551-112789	102%
90-00820*	561-112889	88%
90-00820* sp. dup.	561-112889	120%
90-00829*	590-112989	110%
90-00829* sp. dup.	590-112989	110%

* = Analysis by AA Method: Analyst: M. Templeton

sp. dup. = Duplicate Spike